

302-5.

BULLETIN
NATIONAL LAMP WORKS
OF GENERAL ELECTRIC CO.
ENGINEERING
DEPARTMENT

July 20, 1927

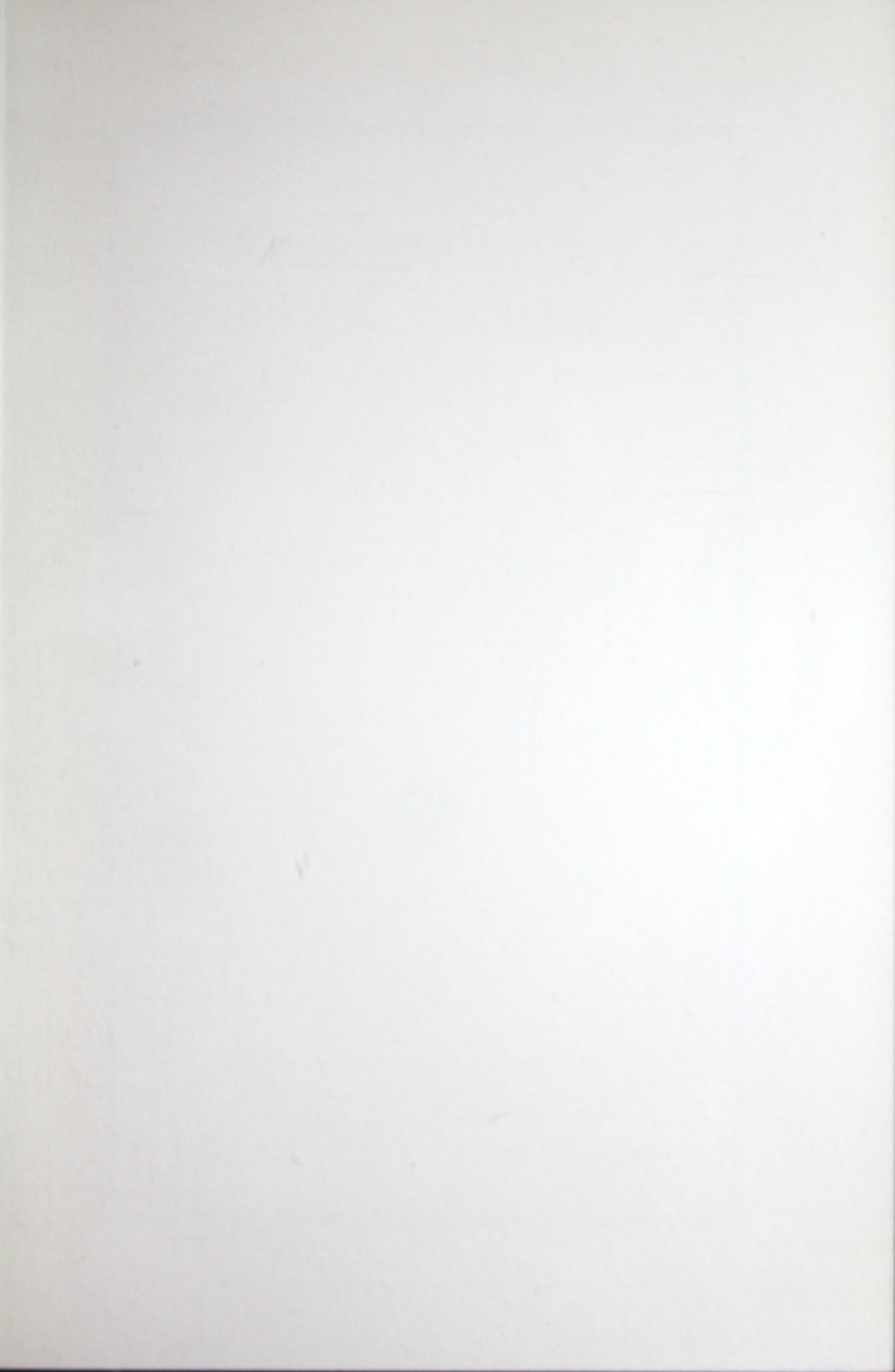
Bulletin 52

Photographic Lighting
with MAZDA Lamps

By

R. E. FARNHAM and K. M. REID







Photographic Lighting with MAZDA Lamps

By

R. E. FARNHAM and K. M. REID



ENGINEERING DEPARTMENT
National Lamp Works of General Electric Co.
NELA PARK : CLEVELAND, OHIO

FOREWORD

This bulletin tells how best to apply light in photography, offers suggestions on the wide range of lighting effects which can be produced with MAZDA lamps and suitable equipment, and shows the color rendition obtained with different emulsions and filters.

TABLE OF CONTENTS

General

	Page
Incandescent Lamps for Photography.....	5
Equipment for Incandescent Lamps.....	9
Fundamentals of Modeling with Light.....	16

Portrait Photography

Desirable Lighting Characteristics.....	19
Lighting for Portrait Photography.....	21

Commercial Photography

Colored Articles.....	39
Lighting for Commercial Photography.....	40

Portrait and Commercial Studios

Darkroom Processes.....	51
Reception Room and Dressing Room.....	54
Lost Illumination.....	55

Appendix

Sensitivity and Wave Length.....	57
Light Control.....	60
Illumination vs. Distance.....	62

121 918846 1CF



An example of skillful manipulation of floodlights.

Photo by Joel Feder, New York.

Photographic Lighting with MAZDA Lamps

LIGHT is the framework upon which the processes and the art of photography are built. The production of an image on the plate, the reproduction of this image on the final print, and other photographic processes utilize the chemical action of light. And just as the palette and brush serve the painter, so does light serve the skilled photographer. It affords a means of modeling the subject—emphasizing certain lines of a machine, portraying the delicate texture of a garment, subordinating certain less attractive features, accentuating some characteristic expression—here is the true artistry of photography, made possible by the control of highlights, shadows, and contrasts.

Until recent years photographers were much handicapped in exercising their creative talents because of the limited lighting effects possible with daylight. The development of a variety of good artificial lighting equipment has eliminated this drawback and has given the photographer free rein in the production of new and artistic effects, any of which can be duplicated at any time. In addition, artificial lighting has freed the photographer from a number of aggravating restrictions. No longer is it necessary to locate the studio on a top floor rather than in more desirable ground floor quarters in a better district; neither are appointments restricted by darkness and by cloudy days, a restriction which is worst during the busiest season. Artificial lighting has thus transformed the business of photography and given a far wider scope to the artist in this profession.

Incandescent Lamps for Photography

MAZDA lamps possess characteristics which make them particularly valuable as photographic illuminants. The light emitted is constant in intensity and quality; it is easily controlled and of a color suitable for all kinds of photography. The lamps themselves are clean, they do not require continual attention, and they operate equally well on either alternating current or direct current. Because of these advantages they are being used more and more widely in both portrait and commercial studios.

PHOTOGRAPHIC LIGHTING WITH MAZDA LAMPS

In order to make possible the wide range of lighting effects required by the expert photographer, MAZDA lamps are available in a variety of sizes and types. Many of these lamps are designed especially for use in photography. For example, the 400-watt round bulb lamps have the highly concentrated filaments essential for small spotlights, while the compact 400-watt tubular bulb lamps are especially applicable to the portable lighting units which are so popular for home portraiture.

MAZDA Photographic Blue lamps, having bulbs of deep blue glass, are recommended for portrait photography. The deep blue glass greatly reduces the brightness to the eye and thus assists in making the subject comfortable, without materially reducing the photographic value of the light with the emulsions ordinarily employed for portrait photography. For practically all other classes of photography, where the reaction of the subject is not involved, clear bulb lamps are recommended. Their light contains a great abundance of the yellow, orange, and red components which are particularly advantageous when used with the panchromatic and orthochromatic emulsions so much employed in the commercial studio.

The light produced by the Photographic Blue lamps is a close approximation to daylight as used by the photographer. Hence objects seen in the light of these lamps appear as they do in daylight, and a photographer may change from daylight to Photographic Blue lamps without the necessity of changing his sense of light values, or he may use the lamps to supplement daylight and his daylight experience will still apply.

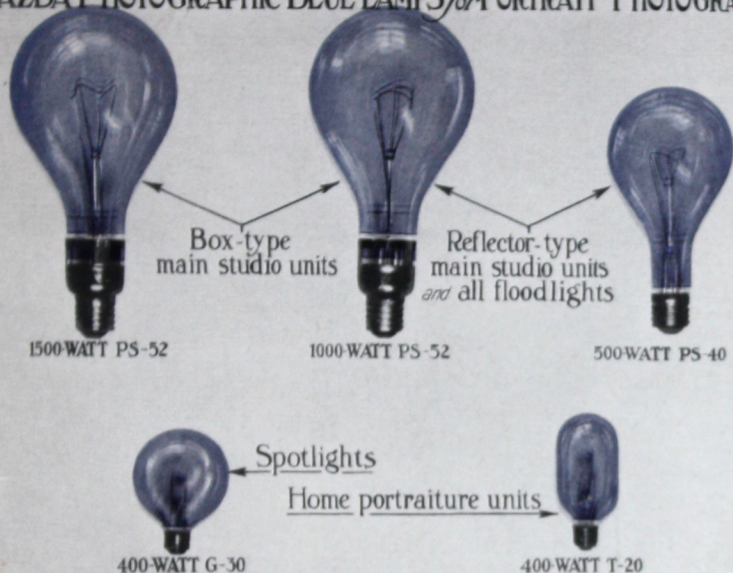
Since the Photographic Blue lamps emit light composed of all colors in substantially equal amounts, these lamps are well suited for color photography. With such plates as the "Autochrome," all colors will appear with the correct balance if the light from Photographic Blue lamps is used.

"Photographic" and "Daylight" Lamps

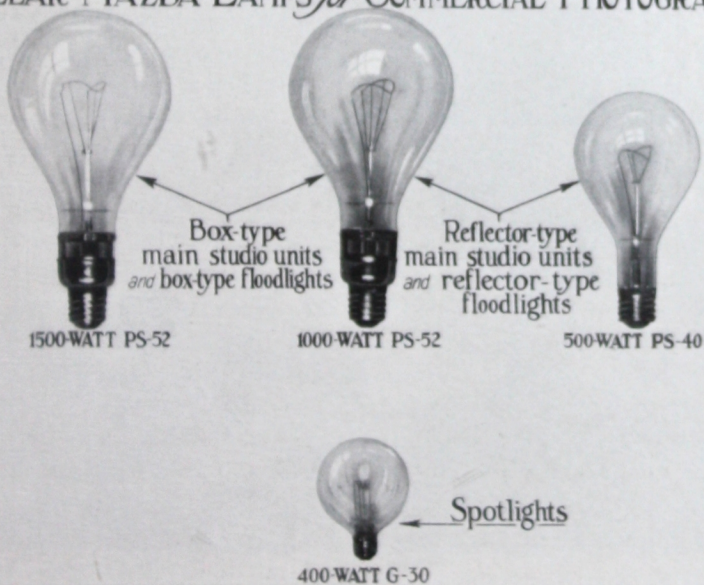
Sometimes it is not understood that there is a difference between the so-called "Daylight" lamp and the Photographic Blue lamp. The "Daylight" lamp is designed for other purposes and its bulb is a much lighter shade of blue, not adapted to photographic work. Photographers are cautioned to observe this distinction and specify MAZDA Photographic Blue lamps—not just "blue lamps."

PHOTOGRAPHIC LIGHTING WITH MAZDA LAMPS

MAZDA PHOTOGRAPHIC BLUE LAMPS *for* PORTRAIT PHOTOGRAPHY



CLEAR MAZDA LAMPS *for* COMMERCIAL PHOTOGRAPHY



There is a MAZDA lamp for every photographic lighting requirement.

PHOTOGRAPHIC LIGHTING WITH MAZDA LAMPS



Photo by Photocraft, Cleveland.

This soft and attractive background consisted of a sheet of tracing cloth, upon the back of which a delicate silhouette pattern of living foliage was projected by a bare lamp.

PHOTOGRAPHIC LIGHTING WITH MAZDA LAMPS

Equipment for Incandescent Lamps

To be fully satisfactory, lighting equipment for both portrait and commercial photography must be "flexible;" that is, there must be a variety of equipment and it must be portable and adjustable. Portability gives the photographer full scope for his work with a minimum amount of equipment. It permits the subject to be photographed from the left or right as best suits each individual case, and places at the command of the photographer the entire range of effects made possible by controlling the direction of light and shadows. Movement of the equipment vertically is also necessary, to provide for seated and standing subjects and for large and small objects. Adjustability of equipment permits adding to the photograph some final touch of artistry such as may depend upon a concentrated spotlight beam in certain cases and upon a somewhat diffused beam in others. Variety of equipment opens the way to a number of effects which can be obtained only through the use of several different types of lighting directed upon the subject from different angles. All of these requirements are met by artificial lighting equipment available for use with MAZDA lamps.

It is usually desirable to group the switches for all equipments close by the camera, to afford the photographer convenient control of his lighting without moving from the point where he wishes to study its effect. Where a light source contains two or more lamps, as in the case of a main studio unit, maximum light control is obtained by having an individual switch for each lamp.

Diffusion of Light

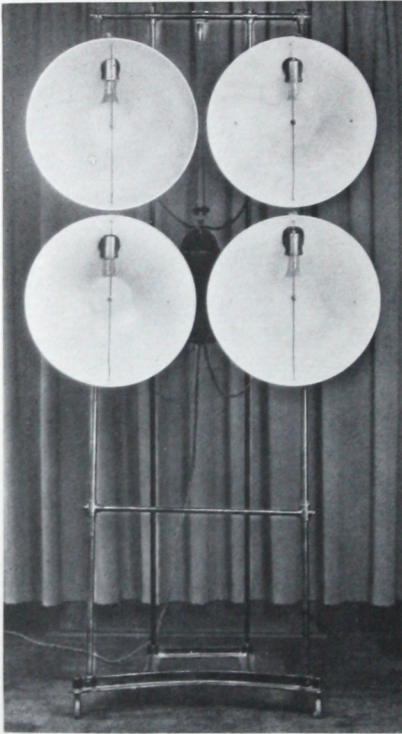
The production of sharply defined shadows or strong highlights calls for a small spot of light, and a correspondingly concentrated light source is necessary. On the other hand, somewhat diffused illumination produces the softness desired in most cases. For this purpose a light source of considerable area is obtained by using several lamps in conjunction with reflectors and screens, or preferably with reflectors alone. In general, considerably greater efficiency is obtained from parabolic reflectors having a semi-mat finish, with the bright lamp filaments shielded by small translucent discs or by frosting of the lamps, than from reflectors covered with diffusing screens; the diffusion is adequate with either type of unit.

Main Studio Lighting Units

The principal illumination for most photographs is provided by the main studio lighting unit. Two general types of units are available—the reflector-type and the box-type.

Reflector-Type

A recently developed main studio unit consists of a group of four parabolic aluminum reflectors, each reflector about two feet in diameter and using a 500-watt or 1000-watt MAZDA Photographic Blue lamp with its filament near the focus. These are arranged in a group to form a single large light source about four feet square. The aluminum surface has a semi-mat finish which, without sacrificing the required control of the light by the parabolic contour of the reflector, affords sufficient diffusion to remove striations and irregularities in the illumination on the subject. That is to say, the lighting is smooth and soft, and a diffusing screen is therefore unnecessary; instead, as a shield from the direct rays of the lamp filament, a small translucent disc or a frosted lamp is used. Ample illumination for even the shorter exposures used by portrait and commercial photographers is obtained with 500-watt MAZDA Photographic Blue lamps. Practically all the



Reflector-type main studio unit.

light from one of these reflectors is concentrated within about 60 degrees, and since the four reflectors are mounted so that they can be aimed independently, all the light can be directed within a comparatively limited angle or it can be spread out to a maximum of about 120 degrees both horizontally and vertically. A separate switch is provided for the individual control of each lamp.

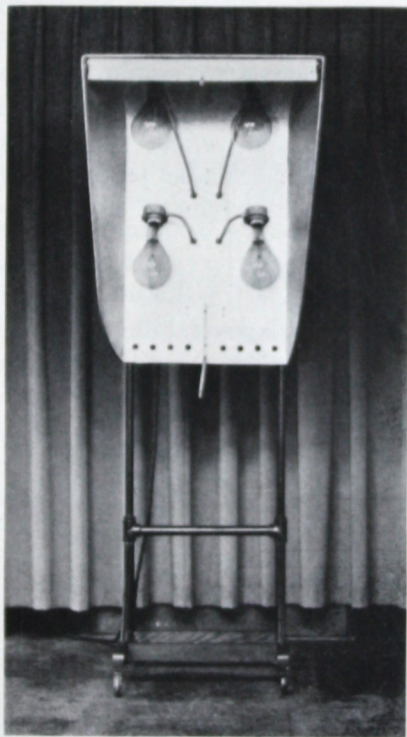
PHOTOGRAPHIC LIGHTING WITH MAZDA LAMPS

Box-Type

The box-type main studio unit has been widely used. This unit is essentially a section of artificial skylight, consisting of a shallow box about three feet wide by four feet high and containing four 1000-watt or 1500-watt MAZDA Photographic Blue lamps. The interior of the box is painted with a white or aluminum paint to increase the light output and the front of the unit is covered with a screen of tracing cloth or China silk to diffuse the light and make the four individual light sources function as a single large one. Units of this type spread the light out over a very wide angle, both horizontally and vertically. This angle covers a considerably greater area than is ordinarily utilized, and hence the box-type units require more wattage than the newer parabolic reflector units to produce a given lighting intensity on the subject.

The reflector-type main studio unit, by controlling the direction of the light and by eliminating the diffusing screen with its resultant absorption, provides approximately twice the intensity of light on the subject with only half the wattage used in a unit of the box-type.

Main studio units of either type should be capable of vertical adjustment sufficient to place the lower edge of the unit about three feet above the floor or the upper edge about nine feet above the floor.



Box-type main studio unit.

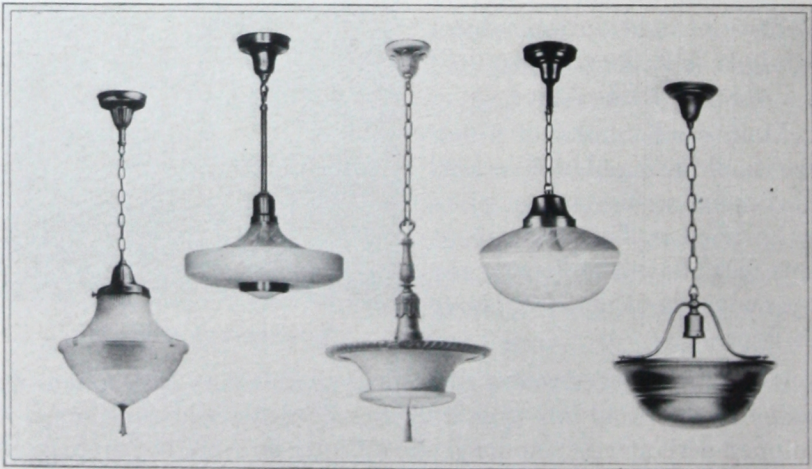
It should be noted that a reflector-type unit may have a housing similar to the usual box-type unit, but if each of the four lamps is equipped with an efficient parabolic reflector as described on page 10 the unit is properly classed as reflector-type, regardless of the design of the supporting frame or housing.

Overhead Lighting

Without overhead illumination, the lighting of the camera room is far from complete. A number of advantages are obtained by employing overhead lighting in conjunction with the main studio unit: first, the general level of illumination on the subject is increased, thereby shortening the time of exposure; second, overhead lighting is very helpful in maintaining satisfactory uniformity of illumination for photographing large groups; third, adequate illumination throughout the room decreases the apparent brightness of the main photographic light sources and materially reduces the glare from them; fourth, the shadows are softened, which is desirable except in the unusual photograph where harsh, sharp shadows are employed to produce a special effect; and fifth, overhead lighting serves to illuminate the background. In the portrait studio general illumination is especially useful as a means of making the subject feel at ease by reducing the glare and creating a natural atmosphere.

Types of Equipment

Although general illumination is obviously desirable, the lighting system must be correctly designed or it will be a detriment rather than a help. For example, the overhead lighting must not control



Typical indirect and semi-indirect lighting units for overhead illumination in the camera room. The two upper units have tops of clear glass.

PHOTOGRAPHIC LIGHTING WITH MAZDA LAMPS

the modeling of the subject by introducing additional highlights and shadows which produce an unnatural or displeasing effect. To avoid this possibility, the overhead lighting equipment should be of the indirect or semi-indirect type. These types throw all or nearly all of the light up to the ceiling, whence it is reflected downward as well-diffused illumination, markedly free from all harsh shadows. The lighting units should, of course, be so located that they provide uniform illumination throughout that part of the studio used for posing the subjects.

Where the ceiling construction does not permit the use of indirect or semi-indirect lighting, direct lighting may be used with fair results.

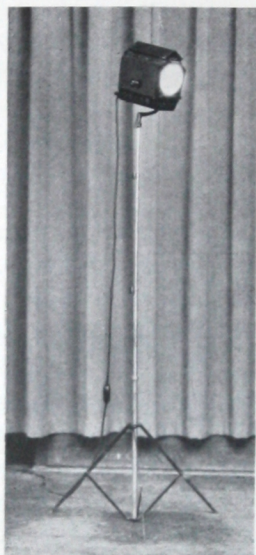
Design Considerations

A fairly high level of general illumination is desirable from the standpoint of shortening the time of exposure and reducing glare. On the other hand, if the general illumination is too high it will flatten out the highlights, shadows, and contrasts to such an extent that the modeling will be largely destroyed. For portrait studios, therefore, illumination supplied by the overhead lighting is rather definitely limited to approximately 8 to 12 foot-candles on a plane about 4 feet above the floor; Photographic Blue lamps provide light of the proper color quality. A general rule, applicable to most portrait studios in which the ceiling height is the usual 12 to 14 feet, is to install four to six lighting units of the indirect or semi-indirect type, space them 6 to 9 feet apart each way, suspend them about $1\frac{1}{2}$ feet below the ceiling, and equip them with 500-watt MAZDA Photographic Blue lamps. In commercial studios, where clear lamps provide light of satisfactory color quality, 500-watt clear MAZDA lamps are recommended. Although the resulting level of illumination is usually 25 to 35 foot-candles, the increase in photographic value is not in the same proportion as the difference in the foot-candle values obtained with Photographic Blue lamps and with clear lamps.

In order to obtain maximum efficiency with indirect or semi-indirect lighting, the ceiling and upper side walls of the room should be painted white; in the camera room cream or yellow is not satisfactory because the reflected light is less actinic.

Spotlights

Photographic spotlights are frequently employed to produce sharply defined shadows, strong highlights, or marked contrasts. To accomplish its purpose, a spotlight must project a concentrated and clearly defined beam of sufficient intensity to throw on part of the subject at least two to three times as much illumination as is received from the other light sources. These results are obtained by a spotlight with a concentrated filament 400-watt



Spotlight.

MAZDA Photographic Blue lamp, placed behind an accurately ground condensing lens of the usual 4 to 6 inch diameter, and employing a spherical mirrored reflector back of the lamp to improve the light utilization and smooth the beam.

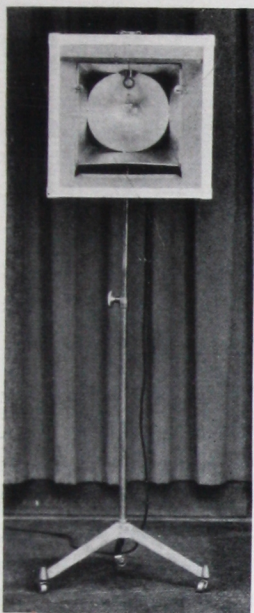
The spotlight is required to produce spots of light ranging from a foot in diameter to more than five feet. An adjustment which permits moving the lamp from 4 inches to within 2 inches of the condensing lens satisfactorily accomplishes this within the usual distances at which the spotlight is placed from the subject. The beam spread as well as the distance from the subject determine the intensity.

Small spotlights are available for use in home portraiture.

Floodlights

In commercial studios particularly, there is need for portable light sources of moderate size to illuminate small objects and also to serve as auxiliaries to the other lighting equipment. Many commercial subjects, such as furniture and machinery, contain areas which because of their location cannot be adequately lighted by the regular equipment, or often it is desirable to make one part of an object stand out by lighting it to a much higher intensity than other parts. Such needs are met by the floodlight. In portrait studios the floodlight is useful for producing unusual effects, such as lighting from below, and for supplementing the

PHOTOGRAPHIC LIGHTING WITH MAZDA LAMPS



Floodlight.

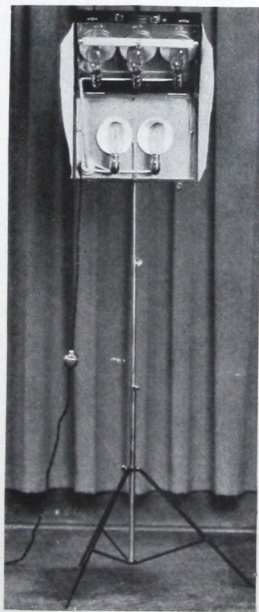
main studio units in photographing large groups. Floodlights are particularly valuable for work done outside of the studio.

Floodlights are obtainable in a variety of types. The single reflector of a contour similar to a paraboloid and with a semi-mat surface gives a relatively high intensity of light with a beam spread of about 60 degrees. They are made for either 500-watt or 1000-watt lamps. Floodlights of the box-type give only about one-fourth as high intensity for a given wattage. Units of this type are available in two sizes, one using a 500-watt lamp and the other using a 1000-watt or 1500-watt lamp. In commercial photography clear bulb MAZDA lamps are recommended for floodlights and in portrait photography MAZDA Photographic Blue lamps should be used.

Home Portraiture Units

Home portraiture lighting units using MAZDA lamps have become very popular. The equipment is light in weight and compact. Since the power must be obtained from the lighting circuits in the home, the wattage is frequently limited to 1000 or 1200 by the capacity of the wire, fuses, or meter. In such cases only three of the five 400-watt MAZDA Photographic Blue lamps in the typical home portraiture equipment can be used. Where it is possible, all five lamps should be used, of course.

In home portraiture photography it is nearly always necessary to use longer exposures than in the studio. This disadvantage is reduced if a lighting unit having the characteristics of the reflector unit shown on page 10 is employed rather than a unit consisting of the relatively inefficient box and diffusing screen.



Home portraiture unit.

PHOTOGRAPHIC LIGHTING WITH MAZDA LAMPS

Fundamentals of Modeling with Light

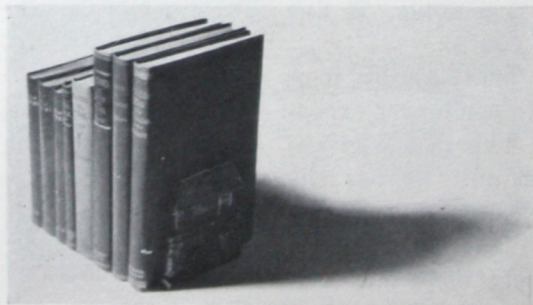
It might be said that a photographer is "artistic" because of his ability to visualize pleasing or distinctive effects, while he deserves to be called "skillful" through his ability to produce those effects by the posing of the subject and by expert manipulation of the lighting. Certain it is that shadows, highlights, and contrasts are of primary importance in photography. Because of this importance, it is well to review briefly the principles underlying the production of lighting effects.

Shadows

A shadow consists of two parts—the dark area which receives no direct light from the source under consideration, and the area of transition which receives a limited amount of light from only a part of the source. The first illustration shows the abrupt transition from light to darkness obtained by using a small light source. "Harsh" or "hard" shadows of this nature are desirable only in the unusual photograph. The second illustration shows the gradual transition obtained by using a light source of considerable size. The transition from the dark to the light area is gradual and the



With a concentrated light source, such as a bare lamp, shadows are harsh and sharp.

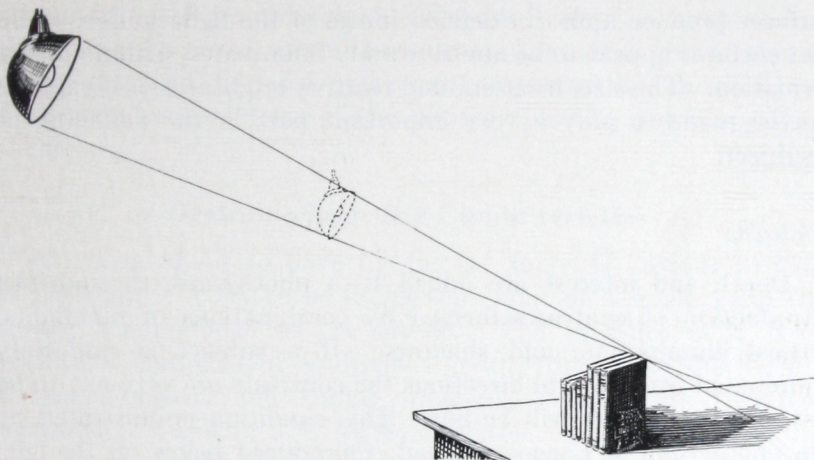


With a somewhat diffused light source, such as a lamp in a reflector, soft shadows are obtained.

PHOTOGRAPHIC LIGHTING WITH MAZDA LAMPS

shadow, as well as the lighting, is spoken of as "soft" or "diffused." Such shadows are most often desired in both portrait and commercial photographs, because they are more natural and pleasing.

The degree of sharpness of a shadow depends not only upon the size of the light source, but also upon the distance of the light source from the subject. The sketch illustrates the principle that



The sharpness of a shadow depends upon the size and distance of the light source.

the sharpness of a shadow remains unchanged providing the diameter of the light source is increased or decreased proportionally whenever the distance of the source from the subject is increased or decreased. In the case of a light source of given size, moving it closer to the subject softens the shadow and moving it farther away sharpens the shadow.

In photography there are several factors which limit the size of the light source and its distance from the subject. If a small light source is placed close to the subject in order to obtain soft shadows, there is likelihood that an unnatural effect will be created by noticeable divergence of shadows. Removing the source to a greater distance and increasing its size proportionally, makes the shadow edges more nearly parallel. However, the lighting unit cannot be made so large as to be unwieldy or to require an abnormally high lamp wattage. For portrait photography and for commercial subjects a desirable softness of shadows is obtained when the subject is placed at a distance approximately two to three times the width of the light source.

PHOTOGRAPHIC LIGHTING WITH MAZDA LAMPS

Highlights

A highlight is a reflected image of the light source. The location of a highlight depends upon the relative positions of the light source, subject, and camera, and the size of highlight is governed by the size of the light source, its distance from the subject, and the curvature and character of the incident surface. Polished surfaces produce a clearly defined image of the light source, while mat surfaces appear to be almost evenly illuminated with no image formation. The size, location, and relative brightness of highlights can be made to play a very important part in the modeling of a subject.

Contrasts

Depth and interest are added to a photograph through the introduction of contrasts formed by combinations of highlights, general illumination, and shadows. If a subject is uniformly illuminated from several directions the contrasts are very apt to be lost and the picture will be flat. This condition is illustrated by the photograph of Laocoön's head, reproduced below on the left; the expression is almost entirely obliterated. However, if the majority of the light comes from one direction, in this case from above, the second illustration shows that the proper contrasts are obtained and the face takes on the expression intended by the sculptor. In case light comes entirely from one side, the contrasts are extreme and again it becomes difficult to distinguish detail.



Absence of contrasts.

Proper contrasts.

Extreme contrasts.

PORTRAIT PHOTOGRAPHY

The purpose of the photographic portrait is to reproduce a natural likeness of the subject, to catch and record personality. The portrait which will live is the one that shows a familiar position of the head, a characteristic facial expression, or some little trait associated with the individual. The ideal way to make such a picture would be to catch the subject unawares. Since this is seldom practical, he must be brought to the studio, and it is one of the greatest problems of the photographer to put his subject at ease.

Desirable Lighting Characteristics

A person about to have his picture taken is anxious to look his best and is likely to be under somewhat of a strain amid the strange surroundings of the studio. The presence of a large amount of complicated equipment greatly intensifies this feeling of unnaturalness, and simple unobtrusive units are therefore demanded. Likewise it is highly desirable to have quiet, steady light sources, relatively free from glare. For psychological reasons the color of all the lighting in the studio should be such that people and objects have a normal appearance.

Color Quality of Light

Portrait subjects illuminated entirely by a light of extremely short wave length, such as violet and blue, show to both the eye and the photographic plate a great many facial blemishes and irregularities of skin pigmentation that are not visible under light of the longer wave lengths, such as green, yellow, orange, and red. Hence it is desirable to photograph by these longer wave lengths and thereby reduce excessive retouching, which tends to destroy the naturalness of the finished picture. With this in mind, an increasing number of photographers are obtaining more lifelike pictures with less retouching by the use of panchromatic emulsions and MAZDA Photographic Blue lamps, or even clear lamps. These lamps take advantage of the sensitivity of certain plates and films to the longer wave lengths. The Photographic Blue lamps reduce by absorption the excess of yellow, orange, and red components; the total volume of light, and consequently the glare, is thereby reduced.

PHOTOGRAPHIC LIGHTING WITH MAZDA LAMPS

Distribution of Light

For portraits of individuals or groups of two or three people, the horizontal spread of light should be sufficient to cover the subject and also the reflecting screen. For the usual distance of 6 to 8 feet between the light source and the subject, the spread should be about 50 to 60 degrees. This same angle also holds for larger groups up to about sixteen people, as the light source must be moved farther away to light both ends of the group equally.

The vertical spread of light should be approximately the same as the horizontal, about 50 to 60 degrees. With this spread there is a reduced level of illumination on the legs below the knees, which is an excellent way to make that part of the picture less conspicuous.

Indoors or out, the majority of the light we receive ordinarily comes from above and one side, although a considerable amount is reflected from other directions. The photographer who desires to have his portraits show people as they usually appear must duplicate such lighting effects in the studio. Hence the dominant lighting should in general be directed downward at an angle of about 45 degrees, with auxiliary units to soften shadows. Where a special effect is desired the direction of light will, of course, be appropriately modified.

Quantity of Light

The minimum level of illumination on a portrait subject is determined by the maximum length of time that he can comfortably remain motionless. This is usually about one second for adults, although one-half second is more desirable; for children, the time should be less than one-half second. Using an $f/4.5$ lens and an emulsion such as the Eastman Par Speed or the Cramer Speed-o-Krome or the Agfa Special, satisfactory negatives can be obtained in one-half second with 65 foot-candles of light from the MAZDA Photographic Blue lamp.

If a lens faster or slower than the ones mentioned above is employed, the illumination level may be decreased or increased. Faster emulsions also permit a reduction in the illumination. The amount of light required from auxiliary units, which control the shadow density, need be only one-fourth to one-eighth that furnished by the main light source. In order to appear as a highlight the illumination intensity received from such units as the spotlight must be at least two to three times that on adjacent surfaces.

PHOTOGRAPHIC LIGHTING WITH MAZDA LAMPS

Lighting for Portrait Photography

The photographer should have at his command lighting equipment which will enable him to produce any effects he may desire. Most portrait photographers like to be equipped to take pictures of all subjects—babies, adults, groups, and out-of-studio subjects, even though they may specialize largely on one class of photography. Fortunately, many of the lighting units can be used with very satisfactory results for different types of pictures so that with a moderate investment in equipment the photographer will be in a position to meet the demands for any kind of a picture and to bring out the full possibilities of his subject.

The accompanying table lists complete equipments for the portrait studio and outlines their use.

TABLE 1—PORTRAIT LIGHTING EQUIPMENTS AND THEIR APPLICATIONS

Lighting Equipments	Purposes	Subjects
<i>Overhead Lighting</i> Four or six indirect or semi-indirect units with 500-watt MAZDA Photographic Blue lamps	Reduces exposure time Decreases contrasts Softens shadows	Babies Children Adults Groups
<i>Main Studio Unit</i> Reflector-type with four 500-watt or 1000-watt MAZDA Photographic Blue lamps Box-type with four 1000-watt or 1500-watt MAZDA Photographic Blue lamps	For general modeling	Babies Children Adults Groups
<i>Spotlight</i> One 400-watt G-30 MAZDA Photographic Blue lamp	Provides additional high-lights and special effects	Children Adults
<i>Floodlight</i> One 500-watt or 1000-watt MAZDA Photographic Blue lamp	Produces unusual effects Supplements other units for groups	Babies Children Adults Groups
<i>Reflecting Screen</i> Mirrored and diffusing types with light reflected from main source	Lessens density of shadows	Babies Children Adults Small Groups
<i>Head Screen</i> Light from main source reduced and diffused over part of subject	Produces roundness	Children Adults
<i>Home Portraiture Unit</i> Three to five 400-watt T-20 MAZDA Photographic Blue lamps	Provides general lighting for out-of-studio work	Babies Children Adults Groups

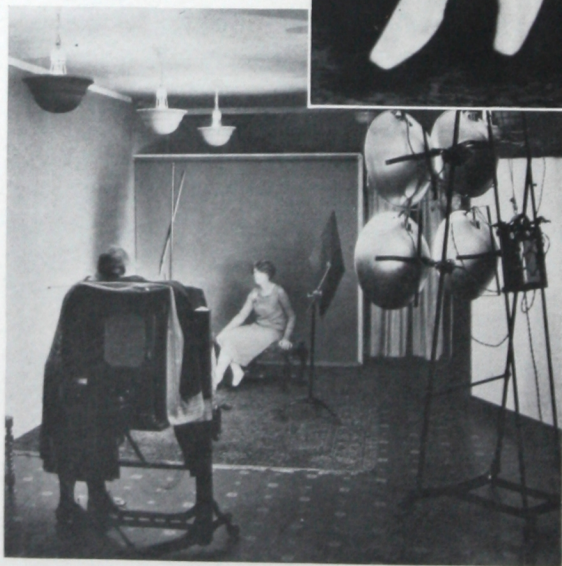
PHOTOGRAPHIC LIGHTING WITH MAZDA LAMPS

Overhead Lighting and Main Studio Unit

The best lighting for most portraits is obtained with a main studio unit and overhead illumination, together with a reflecting screen and, frequently, a head screen. These equipments afford the opportunity of employing a considerable range of lighting effects, especially if the main studio unit is of the reflector-type in which all four lamps may be aimed and switched independently. Without overhead illumination the shadows and contrasts are sharper, a somewhat longer exposure is required, and it is usually more difficult for the subject to assume a natural expression.



*Photo by Standiford Studio,
Cleveland.*



*Overhead lighting, main
studio unit, reflecting
screen, and head screen.*

PHOTOGRAPHIC LIGHTING WITH MAZDA LAMPS

Overhead Lighting, Main Studio Unit, and Spotlight

With certain portrait subjects attractive modeling is obtained by introducing fairly strong highlights in the hair or by outlining the profile with light or by casting a silhouette on the background.



*Photo by Standiford Studio,
Cleveland.*

For such purposes the spotlight, with its concentrated beam of high intensity, is a valuable piece of lighting equipment. Striking effects, suitable only in exceptional cases, are produced by the use of a spotlight without any other lighting, but in the usual application the general illumination of the subject should be provided by other light sources.

*Overhead lighting, main
studio unit, spotlight,
and reflecting screen.*



PHOTOGRAPHIC LIGHTING WITH MAZDA LAMPS

Overhead Lighting, Main Studio Unit, and Floodlight

The floodlight is earning a prominent place in photographic studios as a general utility light source and a means of obtaining unusual effects. It may be used for profile lighting or for introducing highlights in cases where a somewhat less concentrated beam than that of a spotlight is desired. For producing approximately the same intensity of illumination on both sides of the face, a floodlight may be substituted for a reflecting screen. In some instances a floodlight serves excellently as the primary light source.



*Photo by Standiford Studio,
Cleveland.*



*Overhead lighting, main
studio unit, and
floodlight.*

PHOTOGRAPHIC LIGHTING WITH MAZDA LAMPS

Group Pictures

To many photographers the lighting of groups of even moderate size is a difficult problem owing to the inadequacy of their lighting facilities. In the lighting of groups, uniform and satisfactory lighting of the entire group is of major importance and individual members are not singled out for special modeling. The main studio lighting unit is moved back until fairly uniform illumination over the group is secured. For groups of 20 or more, better uniformity of illumination is obtained by using two main light sources. By this means, also, the time of exposure, which is more important than in the case of individuals, is kept within reasonable bounds. General room illumination supplied by the ceiling lighting equipment is particularly important in eliminating harsh effects and reducing the time of exposure.



Overhead lighting and main studio unit.

For photographing a small group, such as a board of directors, seated about a conference table in an office, two to four portable flood-lights with 1000-watt or 1500-watt clear lamps are recommended. The regular room lighting should also be used, wherever possible.

PHOTOGRAPHIC LIGHTING WITH MAZDA LAMPS

Home Portraiture

Home portraiture—comprising individuals, wedding groups, family gatherings, and such subjects—is a very attractive field



Photo by R. H. Tesreau, Cleveland.

Home portraiture unit and floodlight.

that many photographers can develop, particularly to fill in the slack season in the studio. The methods of lighting the subject with home portraiture equipments are the same as employed in the studio. Because of the relatively low illumination received from the room lights they are generally of little or no assistance in lighting the subject. Well-shaded room lights do serve, however, in creating an appropriate setting for a picture taken in the home.

Photographs of Babies and Children

In making pictures of babies and little children, the photographer usually attempts very little modeling and devotes his principal effort toward catching them in the right pose. Many children, when they realize that they are being photographed, become frightened or try to "show off;" hence it is desirable to have the lighting arrangements and also the camera as inconspicuous as possible, so that their attention may be directed by toys or conversation. Excellent illumination for photographing children is provided by the overhead lighting system together with the main studio unit; these two sources supply ample light to make the "snap shots" which are invariably necessary.



Overhead lighting and main studio unit.

PHOTOGRAPHIC LIGHTING WITH MAZDA LAMPS



Photo by G. M. Edmondson, Cleveland.

Overhead lighting, main studio unit, and spotlight.

PHOTOGRAPHIC LIGHTING WITH MAZDA LAMPS



Feodor Chaliapin

Photo by Fernand de Geldre, Chicago.

Floodlight and spotlight.

PHOTOGRAPHIC LIGHTING WITH MAZDA LAMPS



Photo by Nickolas Muray, New York.

Main studio unit and spotlight.

PHOTOGRAPHIC LIGHTING WITH MAZDA LAMPS



Photo by Lewis-Smith, Chicago.

Overhead lighting, main studio unit, and floodlight.

PHOTOGRAPHIC LIGHTING WITH MAZDA LAMPS



Photo by Frank Bill, Cleveland.

Overhead lighting and main studio unit,

PHOTOGRAPHIC

With Various Emulsions

Color chart photographed



Photographed on

Daylight
K-3 Filter



MAZDA Photographic
Blue Lamps
K-3 Filter



Clear MAZDA Lamps
K-1 Filter



Clear MAZDA Lamps
No Filter

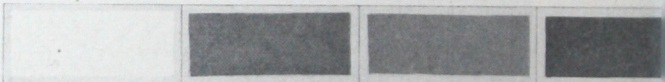


Photographed on C

Daylight
K-1 Filter

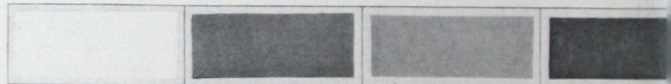


Clear MAZDA Lamps
No Filter



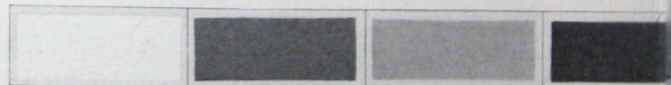
Photographed on T

MAZDA Photographic
Blue Lamps
No Filter



Photographed on

Daylight; also Photo-
graphic Blue and Clear
MAZDA Lamps
No Filter



With these charts for reference it is possible to determine the gray which will be obtained when any color is photographed on any emulsion, the filter, and the illuminant which will be used. It is called to the fact that the grays obtained in the above charts are depending upon whether the colors in the

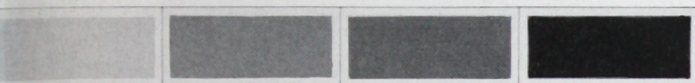
ADDITION OF COLORS

Filters, and Illuminants

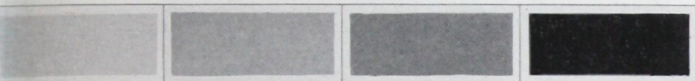


Renditions shown below

achromatic Emulsions



Registers all colors in the visible spectrum



Close duplication of daylight results



Similar results are obtained with daylight and a K-2 filter



Blue region lightened; red region darkened

ochromatic Emulsions



Registers violet, blue, green, and yellow



Close duplication of daylight results

al Portrait Emulsions



Registers violet, blue, and some green

rdinary" Emulsions



Registers only violet and blue

predetermine within reasonable limits the shade of
ographed, and the photographer can thus select the
ost nearly produce the result he wishes. Attention is
ed print will be lighter or darker than those shown
ect are light or darker than those in the color chart.

PHOTOGRAPHIC LIGHTING WITH MAZDA LAMPS



Courtesy Van Raalle Co.

Photo by Joel Feder, New York.

Floodlight only.

PHOTOGRAPHIC LIGHTING WITH MAZDA LAMPS



Courtesy Union Trust Co.

Photos by Photocraft, Cleveland.

Overhead lighting and spotlights.

PHOTOGRAPHIC LIGHTING WITH MAZDA LAMPS



"Fickle"

Photo by Nicholas Haz, New York.

General illumination, two floodlights, and spotlight.

PHOTOGRAPHIC LIGHTING WITH MAZDA LAMPS



Courtesy Granada Theatre

Photo by Kaufmann and Fabry, Chicago.

Lighting permanently installed on building.

PHOTOGRAPHIC LIGHTING WITH MAZDA LAMPS



Courtesy Dobbs and Co.

Photo by W. M. Westercell, New York.

Floodlight and spotlight.

COMMERCIAL PHOTOGRAPHY

The commercial photographer is expected to make photographs that will help sell goods; articles must look attractive, and at the same time faithful reproduction must be obtained. The photograph of a colored woolen blanket or sweater, for example, should show the delicate texture and the many shadings of color, without looking harsh. The picture of a high-priced motor car should have about it the feeling of luxuriousness; the flawless finish should be apparent and the smooth running qualities should be suggested. Machinery should show strength where strength is required. The surroundings and composition of such pictures are very important, but equally as important are the highlights, contrasts, shadows, and color rendition, all of which the properly equipped and resourceful photographer controls at will.

Colored Articles

While color photography is used occasionally by the commercial photographer, nearly all his work is of the so-called black-and-white type in which each color in the subject is represented in the finished print by a different shade of gray. For a correct rendition of these values the plate must be sensitive to all the colors in the subject, and also the light source must have a continuous spectrum—that is, it must contain light of all the different colors. Orthochromatic plates are used where the range of colors extends from yellow to violet, while panchromatic plates or films are necessary if reds are to be rendered as anything except black. Although these emulsions are sensitive to yellow and red, respectively, both of them are relatively more sensitive to blue and violet, as shown graphically on page 58. Therefore, to prevent the resulting picture being dominated by the blue and violet, the volume of light of these colors must be relatively small. With daylight the only choice is to use a filter which reduces the blue and violet components, and to increase the time of exposure. Clear bulb MAZDA lamps, on the other hand, are particularly applicable for this class of photography because of their relatively large output of red, orange, and yellow light. Only the lightest filters are required, if any, and exposure times are shortened. Excellent photographs of such subjects as oak and mahogany furniture, paintings, rugs, and tapestries are made with the light from these lamps, and faithful color separation is obtained. Pages 32 and 33 show the reproduction of various colors with different illuminants, filters, and emulsions.

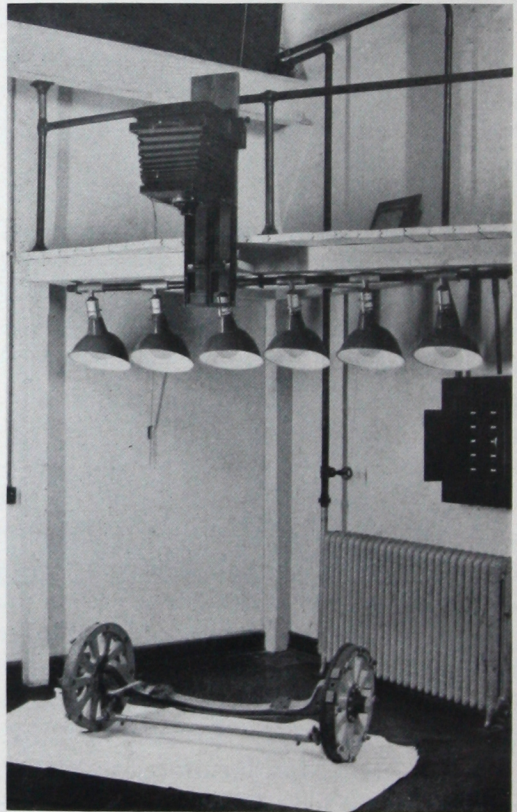
PHOTOGRAPHIC LIGHTING WITH MAZDA LAMPS

Lighting for Commercial Photography

The commercial photographer is called upon to light a great many different classes of subjects. What he needs, therefore, is not so much a high intensity of light as a variety of flexible equipments which will permit him to put light wherever it may be needed. The table on page 41 gives the lighting recommendations for typical commercial subjects. There are, of course, a great many commercial subjects which require individual treatment.

Specialized Rooms

To meet the varied lighting requirements of commercial photography, many of the larger studios have several rooms, each fitted up for a particular class of work. One room, devoted to the photography of wearing apparel on living models, may be lighted in a manner similar to a portrait studio. Another room may be used exclusively for photographing furniture, and be fitted with overhead lights, side lights, and floodlights placed close to the floor. Other rooms may be especially adapted for such purposes as copying and the photographing of machine parts. Where the space is available and the amount of work warrants, this specialization is highly desirable. In some cases it permits the construction of permanent lighting equipment designed especially for the particular type of subject to be handled.



*Special photographic lighting equipment
at the White Motor Co., Cleveland.*

PHOTOGRAPHIC LIGHTING WITH MAZDA LAMPS

TABLE 2—COMMERCIAL LIGHTING EQUIPMENTS AND THEIR APPLICATION

Typical Subjects	Lighting Recommended for Usual Subjects	
	Equipment	Use
<i>Small Subjects— Background Opaqued Machine Parts</i>	Two floodlights with 500-watt* clear MAZDA lamps. Background lighting as described on Page 42.	Articles on horizontal surface—floodlight on each side—photographed from above.
<i>Small Subjects— Background Included Jewelry Small Apparel Toilet Articles</i>	One or two floodlights with 500-watt* clear MAZDA lamps. Spotlight for special effects with 400-watt G-30 clear MAZDA lamp.	Articles attractively arranged with appropriate surroundings—lighting usually from both sides and near camera.
<i>Medium Subjects Furniture Small Machinery Stoves</i>	Overhead room lighting with lamps regularly used. One main studio unit, and auxiliary floodlights as needed, with 500-watt* clear MAZDA lamps.	Subject arranged with appropriate surroundings, unless background is to be opaqued—lighting usually from both sides and near camera.
<i>Large Subjects Automobiles Large Machinery</i>	Overhead room lighting with lamps regularly used. Two main studio units, and auxiliary floodlights as needed, with 1000-watt or 1500-watt clear MAZDA lamps.	Lighting units located so as to provide fairly even illumination over the subject.
<i>Flat Subjects Drawings Maps Pictures</i>	Copy less than 15 sq. ft., two floodlights; larger copy, four floodlights, with 1000-watt clear MAZDA lamps.	Copy on vertical or horizontal copy board—floodlights placed to give even illumination of copy, without specular reflections into lens.
<i>Models Clothing Coiffures</i>	Portrait lighting equipments and lamps.	Free use of floodlights and spotlights to emphasize certain details.
<i>Banquets</i>	Overhead room lighting with lamps regularly used. Auxiliary floodlights with 1000-watt or 1500-watt clear MAZDA lamps.	Put room lighting in best possible condition. Obtain total of 4 to 6 watts per square foot of floor area with auxiliary floodlights, placed to give even illumination.
<i>Night Photographs Room Interiors Show Windows Night Scenes Building Exteriors</i>	Lighting and lamps regularly used. Auxiliary floodlights as needed with 1000-watt or 1500-watt clear MAZDA lamps.	Put regular lighting in best possible condition. Use auxiliary floodlights as required in room interiors.
<i>Out-of-Studio Work Small, Medium, or Large Subjects</i>	Floodlights with 1000-watt or 1500-watt clear MAZDA lamps. Spotlights with 400-watt G-30 clear MAZDA lamps.	Number, location, and manipulation of light sources depend upon the subject.

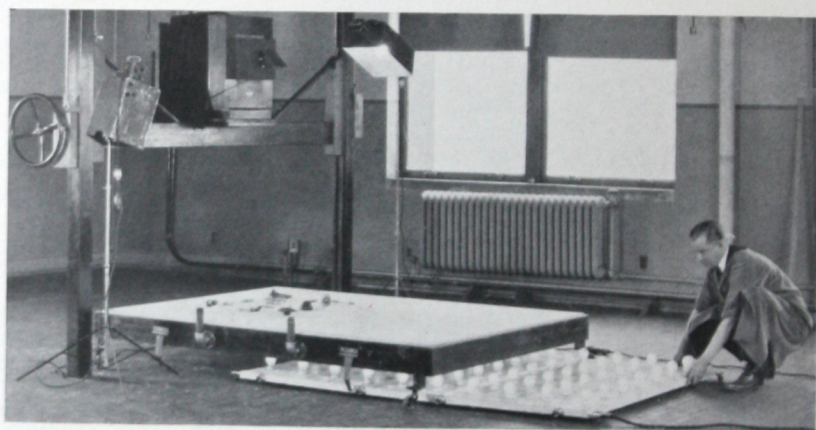
* Use 500-watt lamps with floodlights and main studio units which have efficient reflectors of essentially parabolic contour; with reflectors of the box type, use 1000-watt lamps.

PHOTOGRAPHIC LIGHTING WITH MAZDA LAMPS

Small Subjects—Background Opaqued

The difficulty in photographing small subjects such as machine parts lies in the opaquing of the background. The illumination of the machine parts themselves is usually provided by two floodlights, placed on opposite sides of the platform. To avoid flatness there must be a difference in the illumination from the floodlights, which may be obtained by a difference in wattage, distance, or direction. The shadows should, of course, not be so sharp as to hide detail. Likewise, softness of shadows facilitates the opaquing of negatives by hand.

Hand opaquing is almost entirely obviated by the use of a "light box." The bottom of the box is studded with 50-watt inside-frosted lamps spaced 5 to 6 inches apart. A sheet of ground



Background-opaquing equipment constructed by Mr. Philip Filmer, of the General Motors Photographic Department.

glass, tracing cloth, or similar diffusing material, is mounted about 4 inches below the top of the box, and a sheet of clear glass is laid on top of the box. The articles to be photographed are placed on the top glass and illuminated in the usual manner—that is, by two floodlights placed on either side of the box and above it. The camera is, of course, pointed downward. The top glass practically eliminates all shadows and the illuminated diffusing material furnishes a white background equal to that obtained by opaquing. The exposure can be continued, if necessary, using only the lights at the bottom of the box after the upper lights have been turned off.

PHOTOGRAPHIC LIGHTING WITH MAZDA LAMPS

Small Subjects—Background Included

Many photographers have acquired remarkable skill in creating attractive and appropriate settings for small commercial subjects such as jewelry, toilet articles, and small articles of wearing apparel. Highlights, shadows, and contrasts play an unusually important part in the modeling of these subjects, and light may be used to emphasize a certain object in a display. By rubbing putty over silverware, bright reflections can be eliminated; with silver pitchers, vases, and the like, the same result can be obtained by filling them with water in which there is enough ice to form a frost.



Courtesy Oneida Community, Ltd.

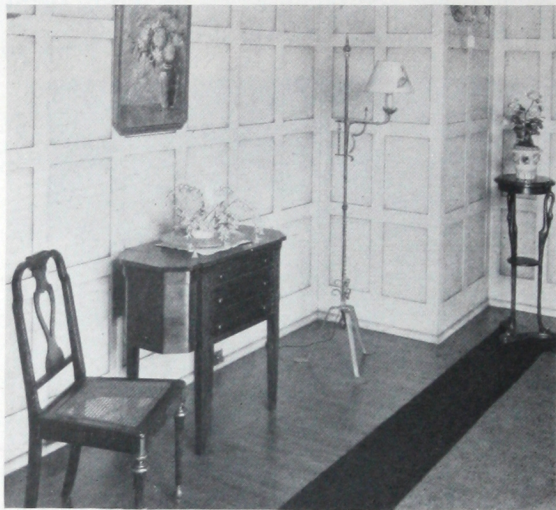
Photo by W. M. Westervelt, New York

Spotlight only.

PHOTOGRAPHIC LIGHTING WITH MAZDA LAMPS

Subjects of Medium Size

With the proper equipments, no difficulty is ordinarily experienced in obtaining the uniformity of illumination required for photographing the usual commercial subjects of medium size. The overhead lighting in the studio and one or two main studio units, together with auxiliary floodlights to light such places as the under parts of office desks, meet the requirements in most cases. Outside the studio, two or more floodlights are usually to be recommended.



(Above)

Photo by Ernst Studio Co.,
Cleveland.

Courtesy
White Sewing Machine Corp.

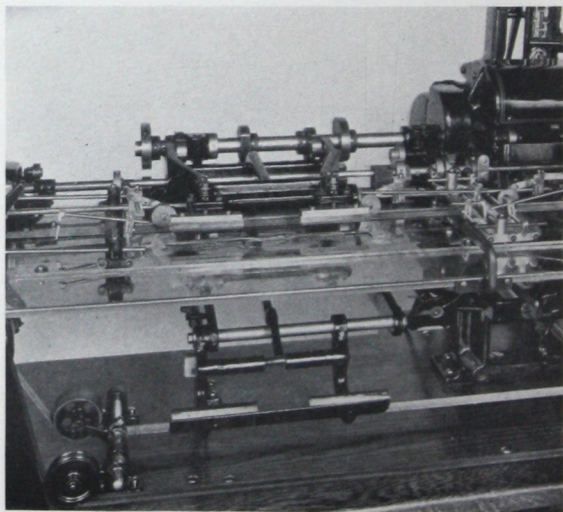
*Room lights, two
floodlights.*

(Right)

Photo by J. J. Johnson,
Chicago.

Courtesy
Addressograph Co.

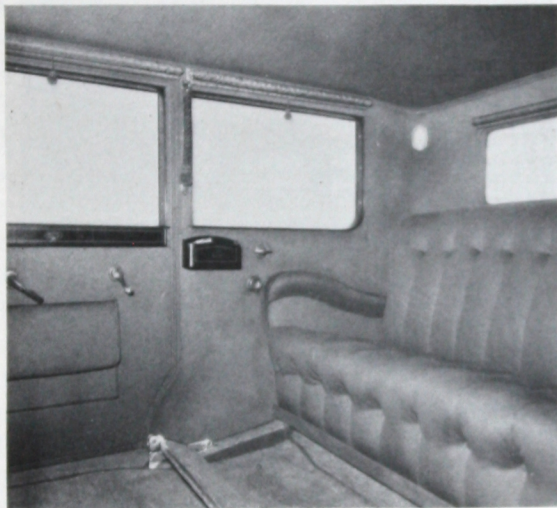
Two floodlights.



PHOTOGRAPHIC LIGHTING WITH MAZDA LAMPS

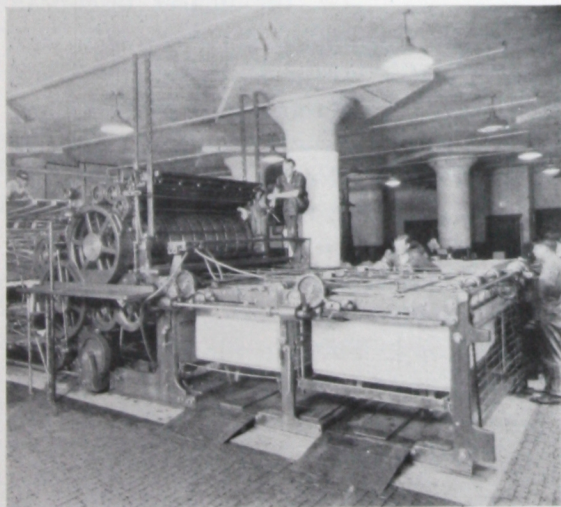
Large Subjects

In photographing large commercial subjects the overhead lighting, main studio units, and floodlights afford ample flexibility of illumination if the subject can be brought into the studio. However, large subjects must usually be photographed away from the studio, employing floodlights and whatever permanently installed lighting happens to be available. Often the difficulties are increased by having only a limited space in which to place the camera and floodlights. In such cases the light must be "sprayed" over the subject by keeping one or two floodlights in motion throughout the exposure; by this means the effect of larger light sources is obtained, and the shadows are correspondingly less conspicuous.



(Above)
Photo by
General Motors Photographic
Department, Detroit.

Two floodlights.



(Left)
Photo by Ernst Studio Co.,
Cleveland
Courtesy
Penton Press

*Room lights, two
floodlights.*

PHOTOGRAPHIC LIGHTING WITH MAZDA LAMPS

Photographic Copying

The first essential in the photographic copying of drawings, maps, tracings, and other photographs is uniform illumination over the copy. This is most satisfactorily accomplished by the use of floodlights. For the usual sizes of copy, that is, less than fifteen



Vertical copy board, with lighting recommended for copy of moderate size.

square feet, two floodlights are necessary to secure uniform illumination, although copy of letter paper size or smaller can be properly illuminated by a single lamp. Copy larger than approximately fifteen square feet generally requires four or more units. When the surface being copied is glazed or polished, images of the light sources may appear on the copy. These can be eliminated by moving the sources out to the side until the images disappear.

Clear bulb MAZDA lamps are recommended for copying, with any of the three usual types of plates. If the copy contains several different colors, the use of either orthochromatic or panchromatic plates and filters together with this light source will allow accurate and easy discernment of the various colors in the finished print. Blueprints may be successfully photographed by using a panchromatic plate and red color filter.

Using two 1000-watt lamps, a lens working at $f/11$, and a process film, well-timed negatives are made in 5 to 30 seconds exposure, depending on the color of the copy. Suitable allowance must be made for different lens openings, filters, and emulsions.

The lighting of drawings, charts, and photographs for the purpose of making lantern slides follows the same general principles as outlined for copying.

PHOTOGRAPHIC LIGHTING WITH MAZDA LAMPS

Direct Copying Processes

Direct copying processes are those in which copies of drawings, charts, printed material, etc., are made directly on special copying paper such as Photostat paper. With these processes the light and dark areas in the finished print are the reverse of those in the original. Clear

bulb MAZDA lamps provide excellent illumination for this service. Since their light contains all colors, each color in the copy of multi-colored material will be represented by an individual tone. For example, if clear lamps are used in making a Photostatic copy of a typewritten document, printed in black but containing corrections and annotations in red and blue inks, all of these colors will be shown by different

tones and easily differentiated. The methods of illuminating material for direct copying are the same as those for photographic copying. For Photostat paper the time of exposure should be increased three times, compared with Par Speed film, under the same conditions of lens speed and illumination.

Photographs Outside the Studio

For commercial photography outside the studio the general principles of lighting the subject are the same as in the studio. However, the amount of equipment which can be employed in taking photographs outside the studio is necessarily limited, and for this reason the light weight and flexibility of floodlights make them especially desirable. MAZDA lamps have the added advantage of operating on either alternating current or direct current, a consideration of importance in many locations where both types of service exist.



*Horizontal copy board for direct copying
and small photographic copying.*

PHOTOGRAPHIC LIGHTING WITH MAZDA LAMPS

Night Scenes

In making night photographs of such subjects as outdoor scenes, show windows, room interiors, and floodlighted buildings, it is usually necessary to employ only the lighting permanently installed. In some cases supplementary lighting may be used to illuminate dark areas or to produce a special effect. A good general rule for one who is not experienced in this class of photography is to make a liberal estimate of the exposure required, and then double it.

The eye distinguishes a much greater range of contrast than the camera can reproduce. As a result, in photographing night scenes and the like, there is a tendency toward a picture consisting of spots of light scattered over a background which is largely black and void of detail. This tendency can usually be overcome by the use of the right plate, stop, and exposure; occasionally, however, in order to reproduce a night scene *as it actually appears to the eye*, it is necessary to give a momentary exposure while there is still daylight, then conclude the exposure after darkness has fallen.



Photo by R. H. Tesreau, Cleveland.

Panchromatic plate without filter, stop f/16, exposure 20 minutes.

PHOTOGRAPHIC LIGHTING WITH MAZDA LAMPS



Courtesy The Davis Co.

Photo by Kaufmann and Fabry, Chicago.

Panchromatic plate with filter, stop f/16, exposure 7 minutes.



Courtesy Packard Motor Car Co.

Photo by W. J. McCurdy, Detroit.

Superspeed film without filter, stop f/22, exposure 5 minutes.

PHOTOGRAPHIC LIGHTING WITH MAZDA LAMPS

Banquet Groups

The lighting of large banquet groups can be handled very successfully by a number of floodlights placed along the sides of the hall so as to illuminate uniformly all parts of the assemblage. These floodlights may be quickly and easily installed and removed by the use of flexible cables provided with connectors similar to those used in stage lighting work. In many instances the regular room lighting equipment provides sufficient illumination to assist



Photo by H. Koss, Cleveland.

Regular auditorium lighting and floodlights.

the floodlights materially. To derive the full advantage from the permanently installed equipment, it should be cleaned and otherwise put in the best possible condition. Ample illumination is provided by a total of 4 to 6 watts per square foot of floor area. Using panchromatic plates and clear bulb lamps, satisfactory pictures can be taken with an exposure of from 5 to 10 seconds.

Difficult Brightness Contrasts

Certain subjects are very difficult to photograph because of extreme brightness contrasts between adjacent light colored and dark colored areas. The light colored area will be badly over-exposed if sufficient light is applied to illuminate the dark colored area. By the use of spotlights the photographer can place a considerably higher level of illumination on the dark areas than on the light, and the result is a well-timed negative throughout. Caskets, and occasionally furniture or other commercial subjects, present this lighting problem.

PORTRAIT AND COMMERCIAL STUDIOS

Darkroom Processes

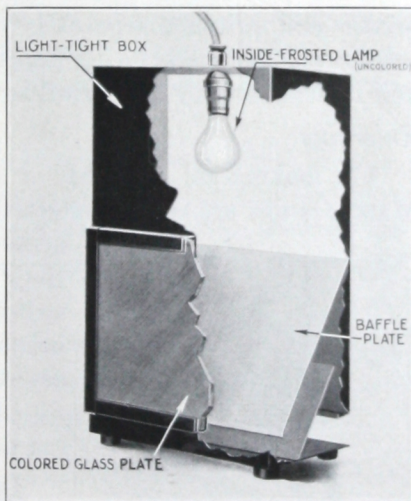
The name "darkroom" is really a misnomer. There can be plenty of light in the darkroom so long as it is safe for the emulsions being employed. Best results are obtained by using inside-frosted lamps equipped with safelights for filtering out the harmful rays. All lighting units should be of a type which permits easy changing of the safelights whenever necessary.

The general illumination should be sufficient to facilitate movement about the room and to provide for the selection of materials. Direct, semi-indirect, or indirect lighting units may be used, equipped with 40-watt inside-frosted lamps with safelights. There should be one overhead lighting unit for about every 100 square feet of floor area.

A local light immediately above the developing tray is necessary for the examination of films and plates during development. A 25-watt inside-frosted lamp with safelight is recommended. To permit easy examination of an entire negative at a glance one must view it with a uniformly light background as from a reflecting surface — not directly against the lamp.

Nothing at all is gained by painting the ceiling, walls, and shelving black. A yellow or orange is usually to be preferred, because even if stray light leaks into the room these colors absorb nearly all of the violet, blue, and green light which might fog the plates and films. With indirect or semi-indirect lighting the ceiling should be a light orange or yellow.

To avoid changing the safelights, most studios have one darkroom for the handling of negatives and another for the development of printing papers. The more complete studios have separate darkrooms fitted with the safelights necessary for the handling of color-sensitive emulsions.



Safelight for developing.

PHOTOGRAPHIC LIGHTING WITH MAZDA LAMPS

Printing

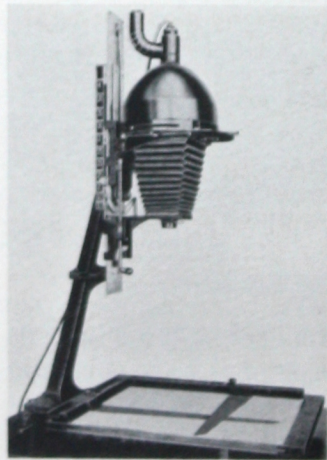
In general, the printer should be equipped with one 100-watt inside-frosted lamp for every 25 square inches of negative area. Thus for the usual 11 by 14 printer six lamps are required, while for the small 5 by 7 printer two lamps are sufficient. With the proper number of lamps spaced evenly below an opal glass diffusing screen and with the interior of the box painted white, uniform illumination of the negative is secured. The current required for even the largest printers can be readily handled by a simple switching device operated automatically by the lever which closes the printer.

The printing of a negative of non-uniform density is facilitated by having each lamp in the printer controlled by a separate switch. By turning out the lamps immediately below the lighter parts of the negative, the exposure over those areas is retarded. This practically eliminates the use of masks.

A 25-watt red or amber lamp, placed in the bottom of the printer and switched separately for continuous burning, is a great help in placing the printing paper and negative in correct register, and it does not fog the printing paper.

Enlarging

For making enlargements or reductions, equipments employing MAZDA lamps are simple, effective, and inexpensive. They permit accurate timing of the exposure because they light up immediately when the switch is closed and are extinguished immediately when it is opened. There are two types of enlargers, usually called reflector enlargers and condensing lens enlargers.



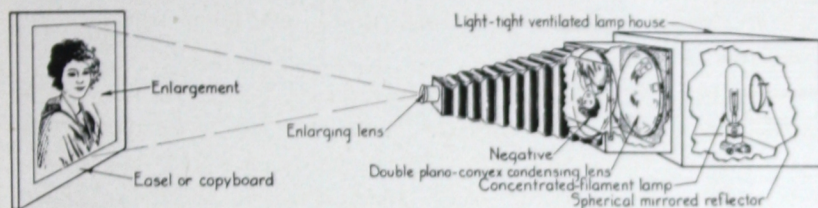
Automatic-focusing reflector enlarger.

In a reflector enlarger, a standard MAZDA lamp with an elliptical reflector and an opal glass diffusing screen illuminates the negative uniformly. Reflector enlargers generally operate in the vertical position and are employed for enlargements up to about three times the original size. Several of these enlargers are automatic-focusing;

PHOTOGRAPHIC LIGHTING WITH MAZDA LAMPS

whenever the enlarger is moved up or down to regulate the size of the printed picture, the lens is automatically moved to keep the negative constantly in focus on the printing paper. This automatic feature is highly desirable where a quantity of enlarging is done.

A condensing lens enlarger consists of a MAZDA concentrated-filament projector lamp and a condensing lens having a diameter slightly greater than the diagonal of the largest negative that will



Principal elements of a condensing lens enlarger.

be used. Condensing lens enlargers are employed for very large ratios of enlargement, and they are usually of the horizontal type. Their mechanical construction does not adapt them for automatic-focusing operation.

The exposure times for making enlargements vary greatly, depending upon the size of the print, the density of the negative, and the speed of the paper. Exposures of one to ten seconds are the rule, although thirty seconds are sometimes required for large prints from dense negatives.

The accompanying table shows the sizes and types of MAZDA lamps recommended for various enlargers.

TABLE 3—MAZDA LAMPS RECOMMENDED FOR ENLARGERS

Enlarger	Negative Size in Inches	Lamps Recommended		
		Watts	Bulb	Type
Reflector Type	4 x 5 and smaller	100	A-23 Inside Frosted	Standard
		150	PS-25 Clear	
	5 x 7 and smaller	150	PS-25 Clear	Standard
		200	PS-30 Clear	
	8 x 10 and smaller	500	PS-40 Clear	Standard
Condensing Lens Type	5 x 7 and smaller	500	T-20 Clear	Projector
	8 x 10 and larger	1000	T-20 Clear	Projector

Reception Room and Dressing Room

The reception room is the photographer's sales room. Here he has the opportunity of exhibiting his pictures under the most favorable conditions. The decoration and the lighting of the reception room reflect his taste and skill, and enable him to place his clients in the most favorable mood. Since the warmer and brighter tones not only create a desirable psychological effect, but actually help people to look their best, they are to be preferred to the colder tones.



Reception room of the Frank Moore Studio, Cleveland.

Table lamps, floor lamps, and shaded wall brackets of appropriate form and coloring are effective in lighting the reception room. One or two of the table or floor lamps may well be of the direct-indirect type which throws most of the light upward for general illumination. Bare lamps in wall brackets or in ceiling fixtures should never be used, because they are glaring and displeasing. They should always be equipped with suitable shades of glass, fabric, or parchment.

The consultation over the type of photograph desired, and the selection of proofs for final finishing, can best be conducted at a table where a floor or table lamp assists in giving an air of privacy.

Dressing rooms are usually small, and good general illumination is provided by direct or semi-indirect ceiling fixtures. Shaded bracket lamps should be provided on both sides of the dressing tables.

PHOTOGRAPHIC LIGHTING WITH MAZDA LAMPS

Lost Illumination

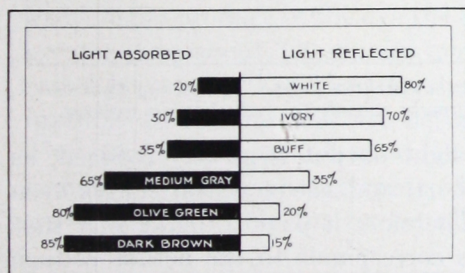
More than half of the light paid for is often lost through neglected maintenance. Unfortunately a falling off of illumination is seldom apparent until undertimed negatives are produced, because the reduction is gradual and escapes notice. As a means of avoiding unsatisfactory lighting service, it is well worth while to consider the causes of lighting depreciation and their remedies.

Getting Light from Soap and Water

First, all lamps and reflectors should be kept clean. Even in a comparatively clean district there is enough dust, smoke, and soot in the air to necessitate regular cleaning of the lighting equipment once a month. In a smoky district more frequent attention is required. The lamps and reflectors should be cleaned by washing them thoroughly with soap and water or with cleaning powder. Likewise it is economy to renew, at intervals of six months to a year, all light-diffusing materials such as tracing cloth, china silk, and buckram, which cannot be washed.

Interior Finish and Illumination

If the walls and ceiling of the camera room are of a dark color, little light is reflected and practically all of the illumination on the subject comes directly from the lighting units; if the walls and ceiling



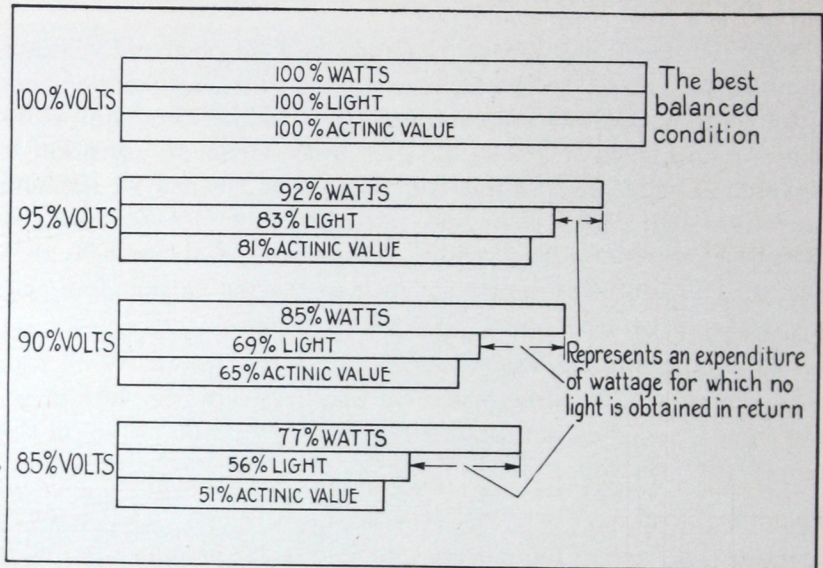
A light colored finish raises the illumination.

are of a light color, they reflect sufficient light to be of considerable aid in softening the shadows and shortening the exposure. Light gray is a suggested color which combines attractive appearance and efficient reflection of actinic light. For the trimmings there are practically no limitations since they contribute very little reflected light. To avoid bothersome specular reflections a mat or semi-mat (not glossy) finish is recommended. In order to maintain their photographic efficiency the walls and ceiling of the camera room should be refinished every year or two, and reflecting surfaces covered with white or aluminum paint should be refinished once a year or oftener. Curtains and shades for windows and skylights should be of attractively colored but opaque materials. Black material is not recommended because it exerts a depressing influence.

PHOTOGRAPHIC LIGHTING WITH MAZDA LAMPS

Lamps, Voltage, and Light

A small car equipped with a large engine might be an excellent hill-climber, but it would never establish a record for long life. A large car equipped with a small engine, on the other hand, would necessarily proceed at a greatly reduced pace. So it is with lamps and the voltage supplied them. If the voltage is too high, the lamps burn brightly, but their life is unduly shortened.



It is uneconomical to burn lamps at an under-voltage. The loss of light—especially light of actinic value—greatly exceeds the reduction in wattage.

If the voltage is too low, the light output is greatly reduced, as shown in the accompanying chart, and the actinism suffers even more than the light output. Therefore it pays to make sure that the rated voltage of the lamps corresponds to the actual voltage supplied them. When installing additional lighting equipment the wiring should be checked to see that it has sufficient capacity to carry the added load without excessive voltage drop—oversize wires, like oversize tires, are a good investment.

The best lighting results will be obtained by using in each lighting unit only the particular size and type of lamp for which the lighting unit is designed. This is especially important in the case of reflector units, spotlights, and floodlights, which depend upon the light source being in the proper position with respect to the reflecting surface.

APPENDIX

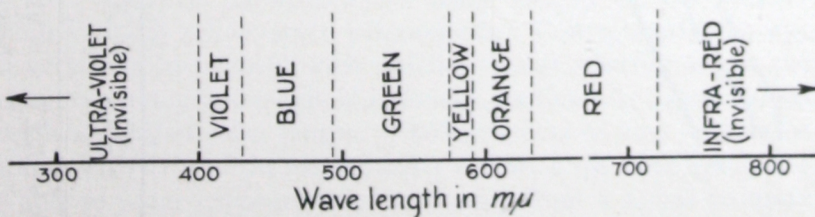
This appendix covers certain subjects which are important for reference because they are fundamental and form the basis of the recommendations included in this bulletin. Such factors are the sensitivity of plates to light of different wave lengths, the reflecting properties of various surfaces, and the characteristics of translucent materials.

Sensitivity and Wave Length

The eye is the final judge in practically all other fields of lighting, and the best quality of light is that which is most pleasing and will permit the eye to function most efficiently. In photography, however, the eye is of secondary importance and the effect of light upon the sensitive photographic film or plate is the major factor.

Since various photographic emulsions are acted upon to a varying extent by light of different colors, the spectral character of the light—that is, the proportions of the various colors which compose the light—is equally as important as the intensity of the light.

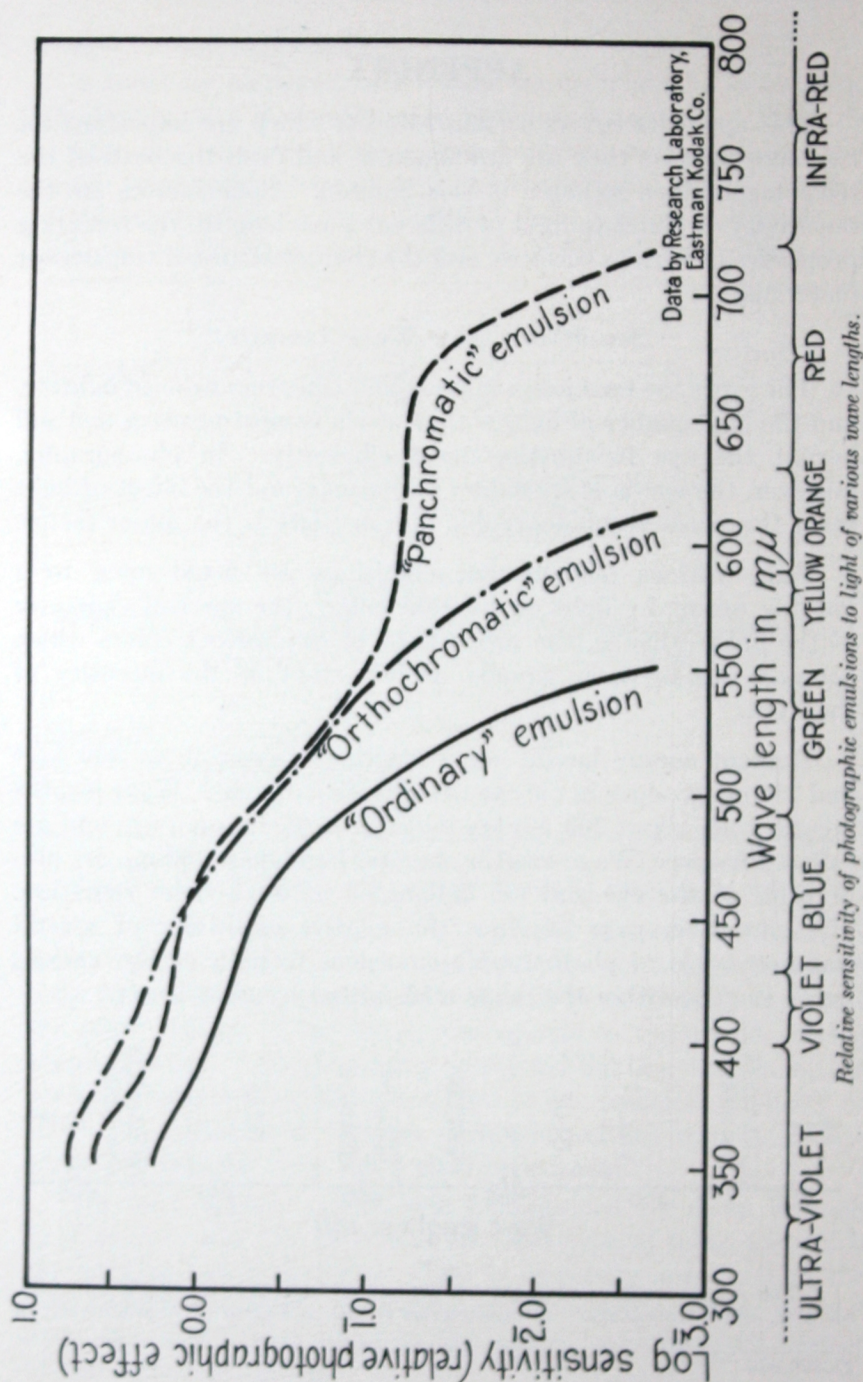
Radiant energy having wave lengths between about 400 $m\mu$ * and 700 $m\mu$ produce in the eye the sensation of light. Wave lengths greater than about 700 $m\mu$ are invisible to the human eye and are called infra-red. Wave lengths shorter than about 400 $m\mu$ are also invisible to the eye and are designated as ultra-violet radiation. The curves on page 58 show the relative sensitivity of several common types of photographic emulsions to light of the various wave lengths within the range transmitted by glass lenses.



* The wave lengths of light radiation are usually expressed in millimicrons, abbreviated $m\mu$. A millimicron is one millionth of a millimeter, or

$\frac{1}{25,400,000}$ inches.

PHOTOGRAPHIC LIGHTING WITH MAZDA LAMPS



PHOTOGRAPHIC LIGHTING WITH MAZDA LAMPS

The panchromatic emulsion is sensitive to all colors of the visible spectrum. It will be noted that this emulsion is much more sensitive in the blue, violet, and ultra-violet region than at the longer wave lengths; this makes apparent the necessity for either a light source containing a relatively large proportion of yellow, orange, and red, such as the clear bulb incandescent lamp, or a yellow filter with the sources containing a high proportion of blue, violet, and ultra-violet, to secure uniform photo-chemical action at all wave lengths (colors).

Orthochromatic films and plates have a more limited color range, being insensitive to the red, orange, and some of the yellow wave lengths. Similar to the panchromatic types, this emulsion is more sensitive to the blue, violet, and ultra-violet radiations, and to obtain balanced photo-chemical action one must employ either yellow filters or light sources predominating in the longer wave lengths.

The so-called "ordinary" emulsion was the forerunner of the other types and has the most limited color sensitivity; it is practically insensitive to wave lengths greater than $540\text{ m}\mu$ (green). Thus it is evident that to cause photo-chemical action on the "ordinary" emulsion, only the shorter waves of the visible spectrum are useful. The "ordinary" film or plate has the property of emphasizing the contrasts and is therefore especially valuable in the copying of drawings, printed material, etc., where strong contrasts are desired.

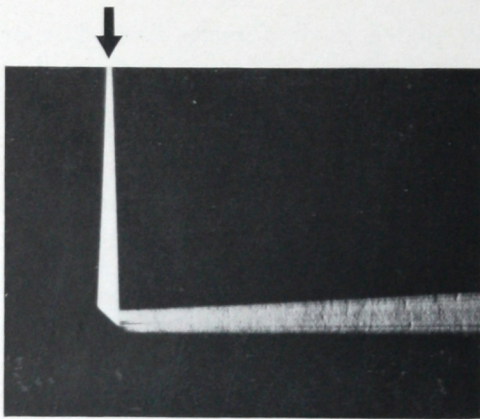
The point of maximum sensitivity of the eye occurs in the yellow-green region, and in comparing two illuminants with the eye their apparent intensities are based largely on the relative amounts of the yellow-green components. Consequently the eye is a very poor instrument with which to judge whether or not the amount of photographic light is sufficient, particularly for emulsions possessing limited color ranges. Photographers of long experience working with light of the same quality and with the same emulsions are able to judge exposure time accurately from a visual estimate of the light intensity. Since photographers are most familiar with daylight, the spectral character of the light from the MAZDA Photographic Blue lamps is markedly advantageous in that this daylight experience still applies.

Light Control

Lenses, reflecting surfaces, and translucent materials are employed to obtain more efficient utilization of the light by directing it where it is wanted, and to produce the effect of a light source of larger area.

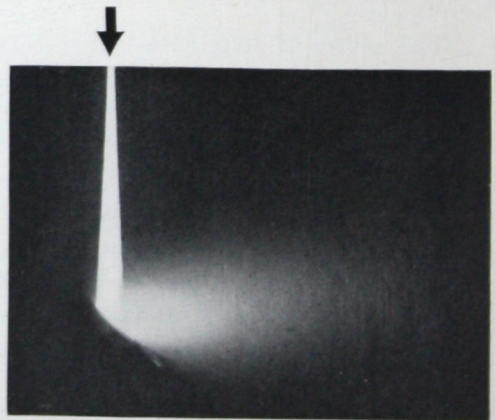
Reflecting Surfaces and Lenses

Reflecting surfaces may be divided into three groups: (a) those which redirect the light in a definite direction with little or no diffusion, such as a glass mirror or polished metal, thereby making it possible to confine a beam within rather definite limits; (b) those which not only redirect the light but also smooth and diffuse it somewhat, such as satin-finished aluminum; and (c) those which diffuse the light more or less completely, such as blotting paper, mat painted surfaces, and unglazed, opaque cloth.



Beam of light reflected from polished metal.

All three forms of reflecting surfaces have a place in photographic lighting. The mirrored reflecting surface is used behind the lamp in a spotlight to direct light, which would otherwise be lost, back through the source and lens. The lens performs the function of confining the rays within a small angle and thus greatly increases the candlepower in those directions where a highly concentrated and accurately controlled beam is desired. A lighting unit which is required to direct a relatively concentrated

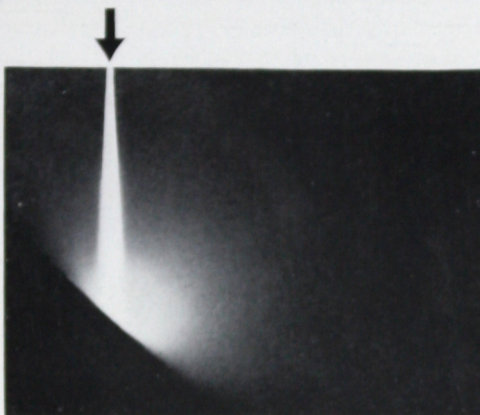


Beam of light reflected from aluminum paint.

PHOTOGRAPHIC LIGHTING WITH MAZDA LAMPS

beam of light and at the same time illuminate the subject uniformly within the beam circle, should use the semi-polished surface which retains control of the light and at the same time gives some diffusion to obtain even illumination.

Diffusing or mat surfaces have two principal applications—the ceiling and walls of the camera room where specular reflections from the overhead lighting system must be avoided, and the reflecting screens used by practically all portrait photographers to provide diffused illumination on the shadow side of the subject.



Beam of light reflected from a mat surface.

Translucent Material

Light-diffusing material should diffuse or spread the light with as little absorption as possible. In the ideal case the entire surface of the diffusing material should be uniformly illuminated and should appear equally bright when viewed from various directions. Such uniformity is extremely difficult of attainment, but the translucent materials at present available, when used in conjunction with properly designed reflecting equipment or several lamps correctly spaced, give a sufficient uniformity to meet any photographic lighting requirements. Data on the more common types of translucent materials are given in the following table.

TABLE 4—PROPERTIES OF SEVERAL TRANSLUCENT MATERIALS

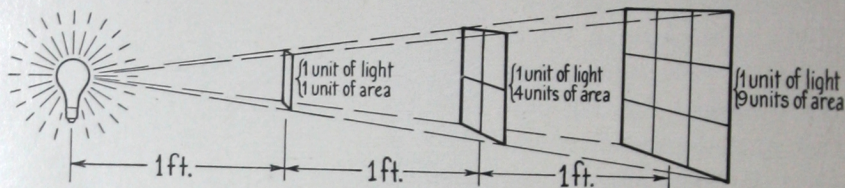
Materials	Per Cent Light Transmitted	Diffusing Properties
Tracing Cloth*	60-70	Good
China Silk	60-70	Fair
Acid-Etched or Ground Glass	85-90	Good
Enamel-Coated Glass	20-30	Excellent
Rippled Glass	80-90	Fair

* Tracing cloth is usually filled with a blue sizing which may alter the spectral character of the light somewhat. However, this is seldom sufficient to cause any material change in exposure or negative quality.

PHOTOGRAPHIC LIGHTING WITH MAZDA LAMPS

Illumination vs. Distance

For a given size of light source, the intensity of illumination on a subject depends largely upon two factors—the candlepower of the source in the direction of the subject and the distance from the light source to the subject. Unless modified by some interfering agency, light waves are propagated from the source along radial



The level of illumination varies inversely as the square of the distance from the light source to the surface.

lines, and it therefore follows that the intensity of the illumination on a surface is inversely proportional to the square of the distance from the light. This law of inverse squares applies strictly only to light radiating from a point source. For finite radiating surfaces such as are characteristic of photographic lighting equipments, there is an increasing departure from this law as the ratio of the greatest dimension of the source to the distance is increased. The following table shows the extent of this departure, computed on the basis of a circular disk light source of uniform brightness.

TABLE 5—DEPARTURE FROM INVERSE SQUARE LAW FOR DIFFERENT RATIOS OF SOURCE DIMENSION TO DISTANCE

Ratio, Greatest Source Dimension to Distance	Departure from Inverse Square Law
1.0	50.0%
0.5	20.0%
0.33	10.0%
0.25	5.9%
0.20	3.8%
0.15	2.2%
0.10	1.0%
0.05	0.25%
Less than 0.05	Negligible Departure

The effect of distance upon illumination intensity, as outlined above, is a fundamental relation which applies to all types of illuminants. It is misleading to state that light falls off more rapidly from some illuminants than from others.

PHOTOGRAPHIC LIGHTING WITH MAZDA LAMPS



Photo by Frank Scott Clark, Detroit.

Stage lighting only.

PHOTOGRAPHIC LIGHTING WITH MAZDA LAMPS



Courtesy Bloomingdale Bros.

Photo by Underwood, New York.

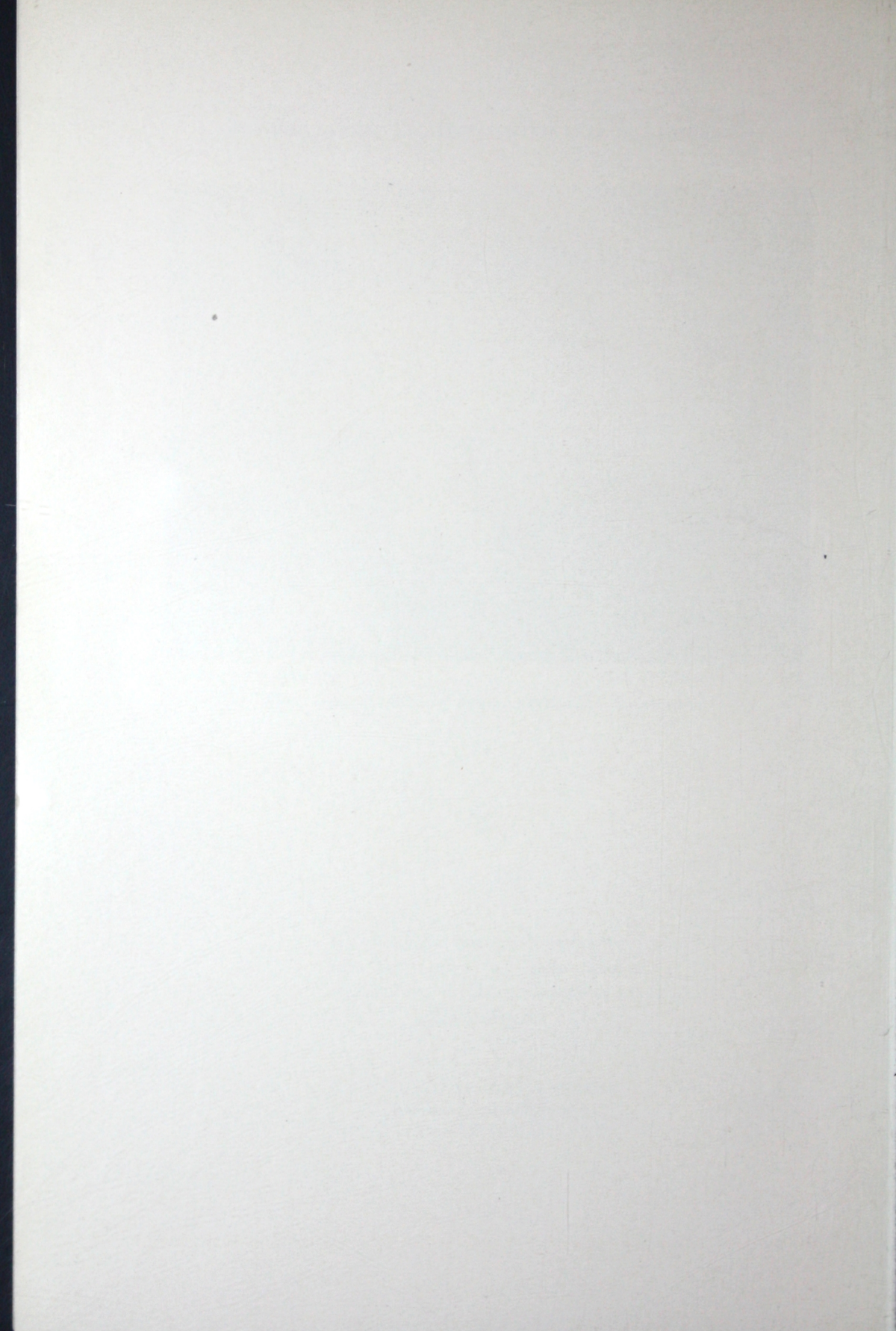
Three banks of 1000-watt lamps, and one lamp by fireplace.



*We thank the many photographers
who have given us their hearty
cooperation in the preparation of
this bulletin.*

ENGINEERING DEPARTMENT
National Lamp Works of
General Electric Co.





BULLETINS OF THE NATIONAL LAMP WORKS

7D—Fundamentals of Illumination

This bulletin presents the principles of light—its measurement, its control and distribution—together with essentials of illumination design.—60 pages.

Illumination Terms, a supplement to Bulletin 7D, is a dictionary of lighting terms.—56 pages.

33B—Motion Picture Projection with MAZDA Lamps

A practical discussion of the principles of MAZDA lamp projection and their application.—48 pages.

Picture Projection for Business, Education, and the Home is a supplement to Bulletin 33B.—16 pages.

41D—Illumination Design Data for Commercial and Industrial Interiors

This bulletin presents a simple method of illumination design adapted to general lighting systems where standard equipment is to be used. Charts and tables simplify the method and make for accuracy in the design.—32 pages.

42A—Factory Lighting Designs

Ready-made illumination plans for the more common bay sizes found in industrial interiors are presented in this bulletin.—48 pages.

44A—Incandescent Lamp Temperatures

This bulletin contains data on operating temperatures of lamps, wiring parts, and fixtures.—36 pages.

45A—Lighting Designs for Stores

Presents lighting recipes for a number of typical store interiors, both large and small, together with designs and notes on lighting of the display windows.—48 pages.

46A—Street Lighting Designs

Urges that all cities outline a complete plan and proceed from year to year with an orderly development of a street lighting program. Simple recipes are given for the lighting of business, thoroughfare, and residence streets for cities of various sizes.—20 pages.

47—Home Lighting Fundamentals

A practical guide for lighting the home, replete with sketches illustrating the use of various types of lighting fixtures to obtain desirable lighting effects in the different rooms.—32 pages.

50A—Electrical Advertising—Its Forms, Characteristics, and Design

This bulletin contains a discussion of the requirements, characteristics, and adaptabilities of the principal forms of electrical advertising, and simple approximate rules to guide the sign user and builder.—48 pages.

51—Night Lighting for Outdoor Sports

This bulletin discusses the various types of equipment and gives comprehensive lighting plans for tennis, volley ball, race tracks, bathing beaches, and a number of other common outdoor recreations.—24 pages.

52—Photographic Lighting with MAZDA Lamps

Analyzes the requirements, describes the equipment, and illustrates the results obtained with MAZDA lamps in portrait and commercial photography.—64 pages.

53—Farm Lighting

Pertinent to the general interest and present widespread activities in farm electrification, this bulletin presents lighting recommendations which are practical and satisfactory for the various farm buildings and the farm home.—36 pages.

Many other publications are available, dealing with specific phases of lighting—schools, hotels, printing plants, cotton mills, automobile headlighting, Christmas lighting, maintenance, etc. When requesting publications, please state the subjects in which you are interested.

THE SALES ORGANIZATION OF THE NATIONAL LAMP WORKS OF GENERAL ELECTRIC CO.

ALLEGHENY LAMP DIVISION	PITTSBURGH, PA.
ATLANTIC LAMP DIVISION	NEW YORK CITY
BUCKEYE LAMP DIVISION	CLEVELAND, OHIO
CONTINENTAL LAMP DIVISION	PHILADELPHIA, PA.
EMPIRE LAMP DIVISION	BUFFALO, N. Y.
FEDERAL LAMP DIVISION	NEW YORK CITY
FEDERAL LAMP DIVISION	CHICAGO, ILL.
MICHIGAN LAMP DIVISION	DETROIT, MICH.
MIDLAND LAMP DIVISION	CHICAGO, ILL.
MISSISSIPPI VALLEY LAMP DIVISION	ST. LOUIS, MO.
NEW ENGLAND LAMP DIVISION	BOSTON, MASS.
NORTHERN LAMP DIVISION	MINNEAPOLIS, MINN.
PACIFIC DIVISION	OAKLAND, CAL.
SOUTHERN LAMP DIVISION	ATLANTA, GA.
SOUTHWESTERN LAMP DIVISION	KANSAS CITY, MO.
SUNBEAM LAMP DIVISION	CHICAGO, ILL.
SUNBEAM LAMP DIVISION	NEW YORK CITY

AT EACH OF THESE OFFICES A LIGHTING
ENGINEER IS AT YOUR SERVICE



ENGINEERING DEPARTMENT

NATIONAL LAMP WORKS



OF GENERAL ELECTRIC CO.

NELA PARK, CLEVELAND

